

Association of Lower Extremity Somatosensation Deficit with Balance and Gait in Sub-Acute Stroke Patients

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ABSTRACT

Background: A stroke occurs when the blood supply to part of your brain is interrupted or reduced, preventing brain tissue from getting oxygen and nutrients. There are three types of stroke ischemic stroke hemiplegic stroke and transient ischemic stroke.

Objective: To determine the association of lower extremity somatosensory deficit in balance and gait in sub-acute stroke patients.

Methods: Cross sectional survey was used in this study. The age group of participants was 40 to 75 years. Sample size was 204 calculated from Rao software and non-probability convenient sampling technique was used. Data was collected from Lahore General Hospital. Data was obtained from patient by applying distal proprioception test to assess the joint position sense. For the assessment of two point discrimination boly gauge was used. The cutaneous vibration sensation was assessed through tuning fork. Soft goat hair brush was used to check the light touch pressure. For balance assessment berg balance scale and time up and go test was used. Gait was observed through Wisconsin gait index.

Results: Mean value and standard deviation of age of participants were 62.99 and 6.592 respectively. There was association of berg balance scale with two point discrimination test, light touch pressure and distal proprioception. There was no association between berg balance scale and vibration sense. Mean value and standard deviation of Wisconsin gait index was 23 and 4.986 respectively. Association between TUG and two point discrimination was found. There was no association of TUG with vibration sense, distal proprioception test and light touch pressure.

Conclusion: This study concluded that balance was affected in sub-acute stroke patients due to the somatosensory deficit. Fall risk increased in the sub-acute stroke patient as the patients performance measured in time up and go test and berg balance scale. It was also inferred that while patients performing Wisconsin gait index scale, gait was affected in sub-acute stroke patients.

Keywords: Balance, Gait, Sub-acute Stroke, fall risk, Somatosensory, Lower extremity

INTRODUCTION

Stroke is the second cause of death worldwide. In 2005, 87percent of deaths happened due to stroke in underdeveloped countries. Stroke prevalence in Thailand is higher than previous studies but not higher than developed countries. (1) In Germany, in prevalence of stroke is 2.9% in adults with the age of 49 -70 years. The prevalence rate increase day by day to 6.3% in females and 8.1% in males in the age of 70-79 years. (2) The prevalence of stroke is 1.2% in the province of KP in Pakistan. The common cause of stroke in Khyber Pakhtunkhwa is diabetes, smoking and obesity. (3) During early development, somatosensory information plays an important role in motor learning and also in achieving more difficult behavioral skills. Abnormal somatosensory function can affect the feed forward and feed backward mechanism of the movements. In neuromuscular disorders, somatosensory function is abnormal. Somatosensory dysfunction can affect the sense of joint position (proprioception) and motor activity and cause impairment as well. (5) Musculoskeletal and neuromuscular system build the balance of body. To maintain the balance of body different sensory system, play important role like vision, proprioception and vestibular system. Due to the lesion of ascending sensory tract, there is impaired balance because of muscle weakness, spasticity and impaired proprioception. (13)

Loss of muscle strength, disturbed motor coordination and loss of range of motion cause impaired balance in hemi paretic patient. After stroke falls are common and fractures due to the fall. Activity limitation occur due the muscle weakness and loss of muscle tone.(14)

In this study, the association of somatosensory deficit with balance and gait in sub-acute stroke patients was observed through the different instruments and tests. This study explains how much balance and gait is affected due to the somatosensory deficit. Patient participation is restricted in daily activities which are affected due to somatosensory loss. It will be helpful in the

rehabilitation plan that how much sensory rehab is required to improve balance and gait and for prevention of fall risk in sub-acute stroke patients.

In 2020, Anastasia Zarkou et al conducted a study on cerebral palsy children to investigate the association of lower extremity somatosensation with functional activities. The somatosensory systems like tactile sensation and two-point discrimination and proprioception were assessed thoroughly. Time up and go, gross motor function test, bestest and 6MIN walk tests, etc. were used to investigate balance, walking abilities and motor function. This study showed that the somatosensory system plays an important role in formulating the motor plan and feed forward and feedback strategies. And somatosensory impairment in cerebral palsy children affects postural stability and mobility. (5)

In 2020 Dorcas BC Gandhi et al conducted a review study on mirror therapy in stroke rehabilitation current perspective.28 studies were reviewed and it was concluded that mirror therapy has strong effects on stroke patients in the different stages of stroke like acute, subacute and chronic. (15)

In 2020 Riccardo landolo et al conducted a study on position sense deficit at the lower limbs in early multiple sclerosis; clinical and neuro correlates. There were 24 participants with relapsing remitting multiple sclerosis and 24 participants were in control group. It was found in this study that there were higher matching errors in patients during contralateral matching tasks than control group while during ipsilateral tasks both groups showed same performance. (16)

In 2020 Roelofs JBM et al conducted a long cohort study on to test the hypothesis that people with minor stroke have persistent balance and gait problem, elevated fall risk and daily activities were affected. Mini bests, Time up and go and 6 ABC score were used in this study. The conclusion of this study was that daily activities were restricted. Balance and gait were deficient after the

complete motor recovery of paretic limb after stroke. Fall risk increase after stroke. (17)

METHODOLOGY

Cross sectional study design was used. Data was collected from, LAHORE GENERAL HOSPITAL. Study was completed within 1 year after approval of synopsis. Sample size was 204(28). It was calculated from Rao software. Non-Probability Convenience Sampling Technique was used. Patient within 3-6 months after the onset of stroke and Age between 40 to 75 years. Those Patients who could sit independently for 30s on a stable surface and both gender somatosensory deficit with balance and gait in sub-acute stroke were included in the study. Patient with anxiety and claustrophobia, Patients with other condition (chemotherapy, Dialysis etc.) And any traumatic injury e.g., brain injury and those Patient with cognition issues and Some other MSK injuries were excluded from the study. Consent was taken from the patients; they were informed about the objective of the study. Then Bolay gauge, tuning fork, soft goat hair brush was used to observe the somatosensations. For the balance assessment, BBS and TUG tests were performed by the patients and a distal proprioception test was performed by the patient to assess the joint position test. For the gait observation Wisconsin gait index was used. Berg balance scale (reliability 0.97-0.98) used for balance assessment, Time up and go (reliability 0.92-0.99) used for risk of falls and Wisconsin gait index was used for gait assessment. Distal proprioception test (for joint position sense). Soft goat hair brush (used for light touch pressure), Bolay gauge (for two-point discrimination) and Tuning fork (used for vibration sense). Data was analyzed by using SPSS 21 statistical software. Qualitative data was analyzed by mean standard deviation and quantitative data was analyzed by standard bar and pie chart

Table 1: Descriptive statistics

Scale and Test	Mean	Std. Deviation
Berg Balance scale	2.1618	.47427
Wisconsin Gait Index	22.9966	4.98637
Time Up And Go	16.0490	1.41336
Distal proprioception Test	1.5588	.49775
Light Touch Pressure	1.6324	.48335
Two Point Discrimination	1.6471	.47906
Vibration Sense	1.5588	.49775

The above mentioned table showed mean and standard deviation of all the tools.

Table 2: Berg Balance Scale and Distal Proprioception Test

		Distal proprioception Test		Total
		yes	No	
Berg Balance scale	41-56 low risk fall	8	1	9
	21-40medium risk fall	75	78	153
	0-20high risk fall	7	35	42
Total		90	114	204

This crosstab showed that 75 participants had positive proprioception test and were on medium risk of fall.

Table 3: Berg Balance Scale and Distal proprioception test chi-square test

	Value	Asymp. Sig. (2-sided)
Pearson Chi-Square	21.646 ^a	.000
Likelihood Ratio	23.804	.000
Linear-by-Linear Association	21.398	.000
N of Valid Cases	204	

a. 1 cells (16.7%) have expected count less than 5.

The above table showed positive association of balance with distal proprioception test.

90 participants showed moderate risk fall in which vibration sense was intact while 113 were on moderate risk fall in which vibration sense was not intact.

Table 4: Vibration Sense and Tug Interpretation Cross-tabulation

		Tug interpretation		Total
		12s-20s-moderate fall risk	21s-29s-high fall risk	
Vibration Sense	Yes	90	0	90
	No	113	1	114
Total		203	1	204

Table 5: TUG interpretation and Vibration Sense Chi-Square Tests

	Value	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.793 ^a	.373		
Continuity Correction	.000	1.000		
Likelihood Ratio	1.168	.280		
Fisher's Exact Test			1.000	.559
Linear-by-Linear Association	.789	.374		
N of Valid Cases	204			

The above mentioned table showed that there was no association between TUG and vibration sense.

Table 6: TUG interpretation and light touch pressure cross-tabulation

		Light Touch Pressure		Total
		Yes	no	
Tug Interpretation	12s-20s-moderate fall risk	75	128	203
	21s-29s-high fall risk	0	1	1
Total		75	129	204

75 participants with intact sensation of light touch & pressure were found on moderate risk of fall.

DISCUSSION

Reem M. Alwhaibi conducted a study on impact of somatosensory training on patients with chronic stroke. It was randomized control study on thirty male and female patients of stroke and divided them into control group and intervention group. Both groups received same treatment except intervention group receive somatosensory rehabilitation as well. Functional independent measures score is improved better in intervention group as compared to control group (p < 0.001). In both groups Quantitative electroencephalography score was not improved. Conclusion of this study was that physical therapy with somatosensory training is better treatment for improvement in the lower extremity function for chronic stroke patient. (34) In contrast in the current study association of somatosensory deficit of lower extremity with balance and gait was observed through cross sectional survey. Mean value and standard deviation of age of participants were 62.99 and 6.592 respectively. There was association of berg balance scale with two-point discrimination test, light touch pressure and distal proprioception were found. Association between berg balance scale and vibration sense was found. Mean value and standard deviation of Wisconsin gait index was 23 and 4.986 respectively. Association between TUG and two-point discrimination was found. There was no association of TUG with vibration sense, distal proprioception test and light touch pressure.

Fenny SF Chia conducted a study on somatosensory retraining of leg after stroke. He reviewed different studies from different databases in which different interventions were used to recover the leg sensory function after stroke. A significant positive summary effect size was found for somatosensory outcomes (: 0.52; 95% confidence interval 0.04 to 1.01; I2 = 74.48%), which included joint position sense, light touch, and two-point discrimination. Positive summary effect size for Berg Balance Scale scores (0.62; 95%confidence interval was 0.10 to 1.14; I2 = 59.05%) was found. Gait summary effect size was not significant. This study concluded that somatosensory retraining has positive impact on improvement of balance but not on gait after stroke. (10)

While in current study association of somatosensory deficit with balance and gait in sub- acute stroke patient was found. Out

of 204 patients 18 (8.82%) were female and 186 (91.18%) were males. Mean value and standard deviation of age of participants were 62.99 and 6.592 respectively. This study shows that there was association of berg balance scale with two-point discrimination test, light touch pressure and distal proprioception. There was no association between berg balance scale and vibration sense. Mean value and standard deviation of Wisconsin gait index was 23 and 4.986.

Hyunsik Yoo conducted a study to find out the correlation of balance, gait and ADLs with somatosensory and motor improvement in stroke patients. There were 101 stroke patients and divided them into the sensory impaired group, sensory normal group and sensory absent group. Results showed that significant difference was ($p < 0.01$). Score of berg balance scale, modified Barthel index, fuget-meier assessment, trunk impairment scale and Functional ambulation category was greater in patients with normal sensory function than patients with sensory impaired function. This study concluded that there was effect of somatosensory function on balance, gait, ADLs and motor recovery. (35)

CONCLUSION

Current study concluded that balance was affected in sub-acute stroke patients due to the somatosensory deficit. Fall risk increased in the sub-acute stroke patient as the patients performance measured in TUG test and BBS. It was also inferred that while patients performing Wisconsin gait index scale gait was affected in sub-acute stroke patients.

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